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Performance of Single- and Four-element Large-area Silicon Drift Detector X-ray Spectrometers for Synchrotron Applications

V. D. Saveliev, L. Feng, C. R. Tull, S. Barkan, M. Takahashi, and E. Damrom

SII NanoTechnology USA Inc., 19865 Nordhoff St., Northridge, CA 91324

Advanced x-ray spectroscopy using synchrotron beams, such as extended x-ray absorption fine structure and x-ray absorption near-edge structure are powerful means for material studies in a wide range of fields such as chemistry, biology, surface and material sciences, geology, and environmental science as well as the state-of-the-art nanoscience. These applications typically require large area detectors or detector arrays with a high-count-rate capability and, for some of synchrotron applications that require magnetic fields such as in techniques utilizing the x-ray magnetic circular dichroism effect, the detector performance must also not be compromised by the magnetic fields. A silicon drift detector (SDD) offers a large active area and excellent energy resolution together with a high-count-rate capability for a wide variety of industrial and scientific applications [1, 2].

We have developed the Vortex® SDD that has a large active area of ~ 45 mm^2, fabricated on ~0.35-mm thick, high-resistivity n-type silicon. These SDDs operate with thermoelectric cooling and feature excellent energy resolution (<130 eV FWHM at 5.9 keV and optimum peaking time). They also exhibit a very short signal rise time (< 100 ns) allowing pulse processing using very short peaking times (~0.25 μs) to achieve very high signal throughput (300–500 kcps output rate). Based on this SDD design we have developed single- and four-element x-ray spectrometers (the Vortex-EM® and Vortex-ME4™) that utilize SDDs installed directly on thermelectric coolers with the heat removed through an innovative heat pipe heat transfer system. This design enables us to develop customized x-ray spectrometers with a detector snout length up to 800 mm for a variety of synchrotron applications, including an ultra-high-vacuum compatible version. The spectrometers utilize the X-Ray Instrumentation Associates digital pulse processors, in particular the 4-channel DXP-xMAP that, in conjunction with the National Instruments PXI/Compact PCI module, offers 4 MB on-board high-speed memory and ~100 MB/s data transfer speed. Performance data of the Vortex® spectrometers, including performance in a high magnetic field, will be presented.

1. S. Barkan, V. Saveliev, J. Iwanczyk, L. Feng, C. Tull, B. Patt, D. Newbury, J. Small, and N. Zaluzec, "A New Improved Silicon Multi-Cathode Detector (SMCD) for Microanalysis and X-ray Mapping Applications," *Microscopy Today*, **12**, 36–37, (2004).
2. P. Lecher, C.Fiorini, R. Hartman, J. Kemmer, N. Krause, P. Leutenegger, A. Longoni, H. Soltau, D. Slotter, R. Slotter, L. Struder, and U. Weber, "Silicon Drift Detectors for High-count-rate X-ray Spectroscopy at Room Temperature," *Nucl. Instr.and Meth. A*, **458**, 281–287, (2001).